EXPERIMENTAL STUDIES UPON THE THORACIC ŒSOPHAGUS—A PRELIMINARY REPORT.

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THE purpose of the experiments outlined in this report is to determine what can be done transpleurally in the treatment of œsophageal stenosis while using the more simple positive pressure method of overcoming the embarrassment necessarily due to collapse of the lung during open chest work.

A few words may first be said concerning the apparatus used, the construction and the method of introduction of the intra-laryngeal tube. The air pump and valve is that designed by Mr. J. T. Hoyt of the physiological department and is of the type mentioned in a former paper.[1] The means of conveying the ether vapor is also the same as used in the experiments detailed in that paper. The canula, however, is much simpler and consists of a plain 8 mm. brass tube 12 in. long slightly curved and rounded at the laryngeal end and supplied with an obturator which tightly fits the rima glottidis. This consists merely of a few turns of surgeons' plaster so wound around the tube as to make a fusiform enlargement of about 12 mm. at its maximum diameter (see photo., Fig. 1). In the side of the tube near the aboral end is bored a small hole of about 2 mm. diameter. This serves as vent for the expired air. Around the tube is a small collar, a piece of tubing, which may be slipped over this aperture when it is necessary to inflate the lungs thoroughly before closing the chest wound. The aperture is sufficient for all expiratory purposes. No partial

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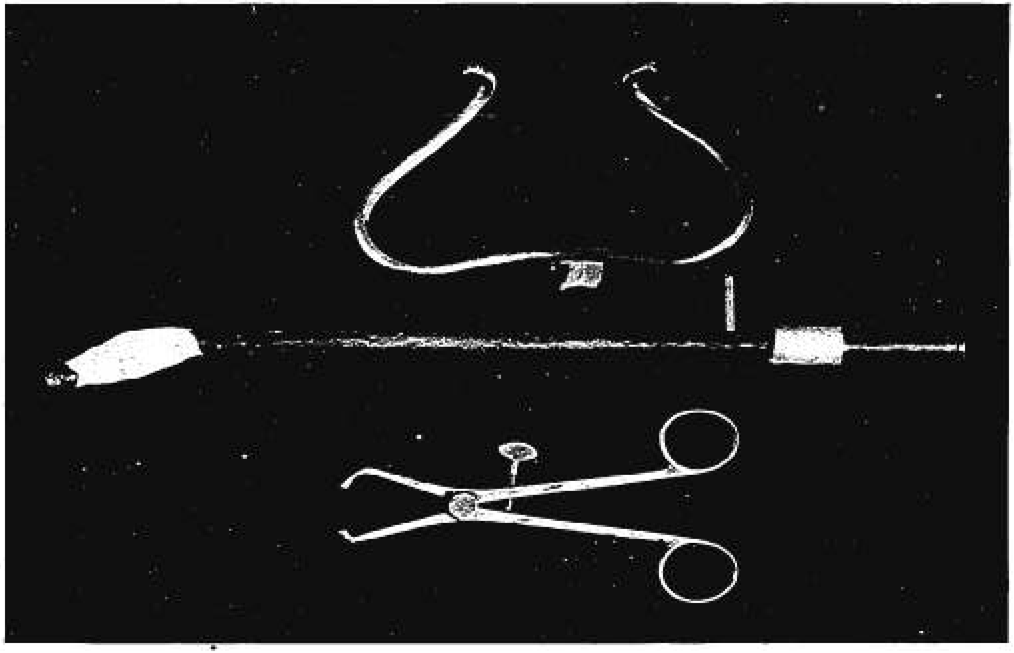
[1] The Positive Pressure Method of Artificial Respiration with a Practical Device for its Application in Thoracic Surgery.—Surgery, Gynecology and Obstetrics, May, '06.

Fig. I.



Instruments to facilitate intra-thoracic work. A match has been inserted in the vent hole referred to in text.

vacuum is used as it was demonstrated to be unnecessary. The intubation tube is held firmly in place by a light clamp made by incurving the blades of an Otis meatal dilator. This clamp is applied oral to the hyoid bone and is so adjusted as not even to bruise the skin under the floor of the mouth. Yet this simple appliance serves to hold the intubation tube firmly in place, and it was noticed repeatedly that neither the pressure from this clamp nor that exerted by the tube itself upon the vocal cords was sufficient to cause the least sign of paralysis. This was shown by the ability of the animal to bark immediately after recovery from anæsthesia.

The introduction of the tube is a very simple matter if attention be given to the following details. In the first place, the primary anæsthetization must be profound. The dog should then be placed squarely on its back with head extended. An attendant slips a towel over the canines of the upper and another over those of the lower jaw holding the mouth very widely open. The operator then holds the tongue in a third towel and draws it forward until the epiglottis is seen. If strong sunlight be thrown from above on the exterior of the neck, the proceeding is much facilitated, for it gives a very striking illumination through the tissues and enables the operator to place the tip of the intubation canula directly in the open rima.

Having completed the intubation and having secured the tube with the clamp, the dog is placed on its right side, a small cushion being tucked underneath the body opposite the site of the operation.

The 6th intercostal space is then located by counting from below up. The skin and superficial muscular incision is made over this space. The tissues are then drawn downward and the pleural cavity opened by sectioning the intercostal muscle midway between the ribs in the 7th space. This gives on closure of the wound an air tight flap—a condition very necessary in the dog, as leakage of air into one pleural space causes collapse of the opposite lung owing to the mobility of the soft parts forming the mediastinum.

Before the pleuritic layer is opened the condition of the lung should be studied by direct inspection and the amount of expansion regulated. This can easily be done as the pleura is quite transparent. Regulation of the expansion may be effected by gauging the volume of air delivered and by changing the size of the expiratory vent by the rubber collar already referred to.

Having opened the pleura, the ribs are then drawn apart and a self-retaining retractor inserted. This retractor, as shown in the photograph (Fig II), consists of a bent brass rod, it having been found more serviceable than the larger instrument designed for human use. The lung is then held out of the way by delicate retraction. This allows an immediate and unobstructed view of the œsophagus, for the ribs at the point of entry separate quite freely.[2] The vagi are usually found as two large trunks with a diagonally communicating branch. From this point on the manipulations must be of the most delicate nature possible. The vagi are carefully separated from the œsophagus by sharp dissection for a distance of 5 cm. Unavoidably much of the serous covering of the œsophagus is removed at this time, but it should be preserved so far as possible. At a point about 1 cm. oral to the point of investiture of the œsophagus by the diaphragm, a cuff of serosa is separated by circular incision around the œsophagus and this cuff is stripped down until the stomach appears in the wound.

The beginning decussation of the vagi on the stomach and the vessels, with the frequent exception of one branch which must be tied—are pushed back on the stomach. At this point the peritoneum appears on the left side and must be opened about half way around the œsophageal end of the stomach. After carefully protecting the cavities by pads a portion of the gastro-œsophageal juncture 2 cm. or more in length is removed. Clamps should not be employed as their use may be followed by a late perforation at the point maximum of pressure. Two retraction Lembert sutures are placed

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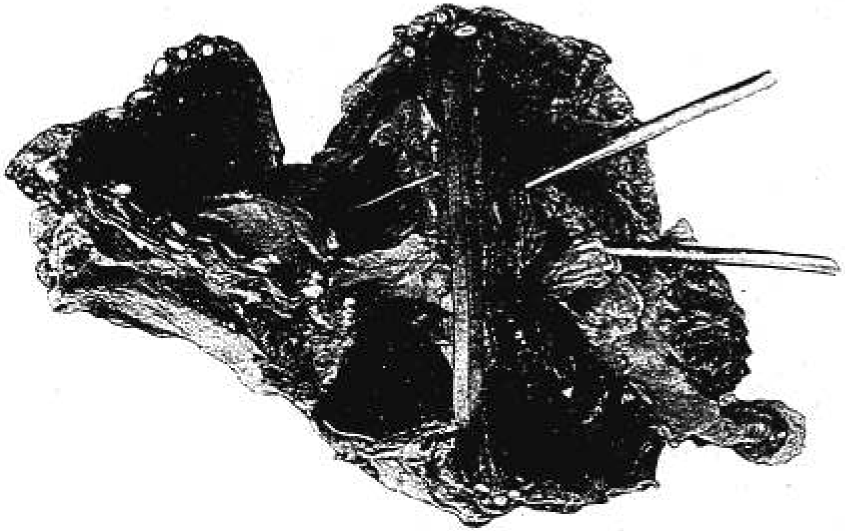
[2] See abstract Sauerbruch's recent technic Kocher: Chirurg. Op. V aufl. p. 737 *et sec.*

FIG. II.



Photograph of entire chest. Ribs spread apart by piece of wood. Stomach split near greater curvature and sounds introduced through the separate openings into œsophagus. A sequestration operation.

Fig. III.

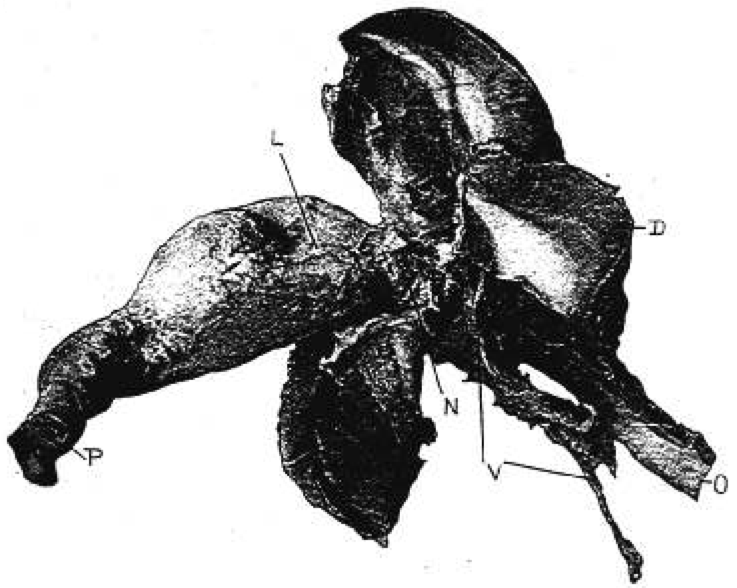


Figure showing appearance of tissues and relations of parts after intra abdominal sequestration of gastro œsophageal union. P, pylorus; L, line of union (between pins) where normal opening of œsophagus was closed; N, new line of union of œsophagus to stomach; D, diaphragm which is seen to be oral to N; O, œsophagus; P. Pylorus, V, vagi.

in the oral part of the œsophagus which is then drawn up into the thoracic wound; the opening plugged with gauze and the stump covered with a pad. The wound caused by the resection of the gastric wall is then closed by a three-layer suture and the stomach is dropped back into the abdominal cavity. An adjacent portion of the cardiac end of the stomach is then grasped in the fingers and drawn up into the chest. Two retraction Lembert sutures are placed in the stomach and this organ incised between them. An end-to-side implantation of the œsophagus into the stomach is then made according to the usual method, three layers of silk sutures being used. The stomach is then dropped back into place again and the diaphragm sutured to the œsophagus oral to the point of union with the stomach, so making the gastro-œsophageal suture line intraperitoneal and within reach of the omentum (Fig. III). The chest cavity is then freed from any blood clots remaining, the positive pressure is slightly increased and the chest wound sutured in layers, leaving a small opening for the escape of air while the lungs are fully distended. This is finally closed and the operation is completed.

The conclusions from these incomplete studies are as follows:

Intubation practised with the simple instruments described is thoroughly practical and for all surgical research work should supersede tracheotomy.

Positive pressure if supplied with a proper cut-off valve is a simple and efficient means for producing artificial respiration in surgical work. We have had no death directly attributable to it.

The flap formation in the chest wound is an important point in the technic.

The protection of the pleural cavity from infection must be rigidly enforced and when the point of resection is near the cardia this may be conveniently accomplished by the sequestration of the gastro-œsophogeal wound into the abdominal cavity. The omentum will then apply itself to the wound area as in any intestinal operation.

Efforts to carry a portion of the omentum into the chest in order to profit by its protecting influence in case the wound area was too oral to allow of intra-peritoneal sequestration were sometimes successful, but it is difficult to maintain the omental blood supply by the method we employed.

In connection with these experiments we wish to report that we have tried gastro-œsophagostomy by means of the Murphy button—by means of end-to-end suture bringing the stomach up through a new opening in the diaphragm—by a lateral anastomosis, by one and also by two stages—and by the twine triangular stitch.[3] This last method we found very satisfactory in side-tracking the natural cardiac orifice. The photograph (Fig. IV) shows a view of a specimen so obtained. Our experience to date leads us to the belief that this or a two stage operation will prove to be the one of election, for the simple one stage intra-thoracic œsophageal section has a very high per cent. of septic mortality (in dogs).

We have also attempted Roux's method[4] of œsophago-jejunostomy. His technic was followed in all respects save that the gut segment was carried up through the chest instead of subcutaneously. Kocher,[5] after describing the method outlined by Roux, states that he essayed it on a man but was obliged to proceed to simple jejunostomy because of the failure of circulation in the isolated jejunal segment. Our results appear to justify the conclusion that in dogs at least the isolation of a portion of the jejunum by Roux's method is impracticable because of circulatory failure.

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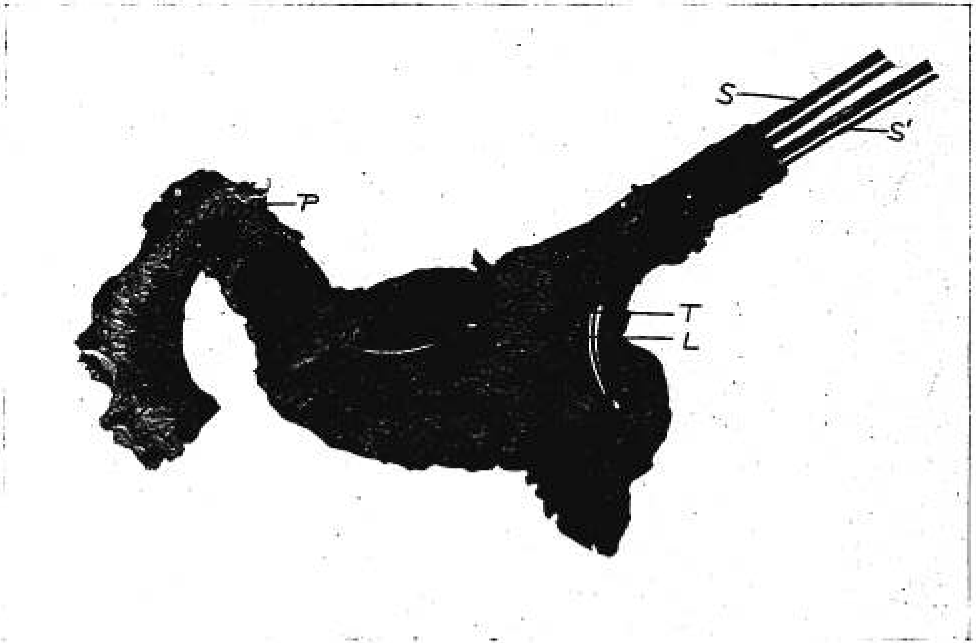
[3] Twine in lieu of the elastic ligature for performing gastroenterostomy, Jour. A. M. A., Sept. 17, '04.

[4] Semaine Médicale, Jan., '07.

[5] Chirurgische Operations lehre, p. 907.

FIG. IV.



Photograph of specimen obtained by using the twine triangular stitch for gastro-esophagostomy. S S′ are sounds which enter œsophagus orally; S′ passes through the triangular stitch opening; S, through natural opening and on into pylorus P; L is a finger of lead pointing to T, the triangular stitch which is just hanging to the margin of the stoma.